

Reductions in Fine Particulate Matter and Improvements in Life Expectancy



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Air Resources Board

California Environmental Protection Agency

Thank you Mr. Goldstene. Good morning, Chairman Nichols and members of the Board. In this health update, I am going to discuss a study that investigated the association between PM_{2.5} and life expectancy in 51 U.S. metropolitan areas, including Los Angeles, San Diego, San Jose, and San Francisco.

We have presented health updates in the past that show an association between PM_{2.5} and premature death. This study asks the question, “Have improvements in air quality over the last 20 years resulted in longer life spans?”

Background

- Long-term and short-term exposure to PM_{2.5} associated with premature death and illness
 - 18,000 (5,600-23,000) deaths per year in California associated with exposure to PM_{2.5}
- As PM_{2.5} declined, has life expectancy increased?*



*Pope, CA et al. (2009). Fine Particulate Air Pollution and Life Expectancy in the United States. *N Engl J Med* 2009; 360:376-386. Supported by the Center for Disease Control and Prevention, U.S. EPA, NIEHS, and the Mary Lou Fulton Professorship, Brigham Young University.

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Many studies have shown an increase in premature death associated with particulate matter. These studies include long-term cohort studies like the Harvard Six Cities and American Cancer Society studies, intervention studies like the Utah Valley steel mill strike and short-term studies like the CALFine study in California.

The effect that particles have on premature death is especially important in California because we estimate that 18,000 premature deaths in California each year can be associated with exposure to PM_{2.5}.

The study presented to you today, by Dr. Pope and colleagues, evaluates how the changes in PM_{2.5} from approximately 1980 to 2000 have impacted life expectancy. This type of study has the advantage of accounting for both short-term and long-term changes in PM_{2.5}. It also helps answer the question of whether the observed deaths would have happened in a few days or much later.

Study Design

- Life Expectancy and PM2.5 Levels
 - 51 U.S. metropolitan areas, including Los Angeles, San Diego, San Francisco, and San Jose
- Study time period
 - Compare 1978-82 to 1999-2000
- Controlled for:
 - Socioeconomic status: income, % high school graduates
 - Demographic characteristics: race/ethnicity, urban residence
 - Smoking: deaths from lung cancer, COPD



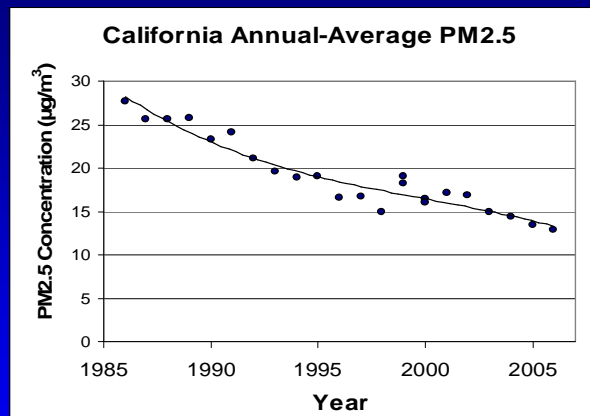
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In the study presented today, researchers matched two sets of data from 51 cities across the nation, including Los Angeles, San Diego, San Francisco, and San Jose. The changes in air pollution between 1980 and 2000 were matched to death statistics to track longevity during the same period.

The research team analyzed air pollution data gathered by the U.S. Environmental Protection Agency from 1978 to 1982, and 1999 to 2000. There was no national monitoring network between 1983 and 1999.

The scientists applied advanced statistical models to account for other factors that could affect average life spans, such as socioeconomic status as measured by income and high school graduation rate. The study also controlled for demographic characteristics and deaths from lung cancer and chronic obstructive pulmonary disease, a proxy for cigarette smoking.

PM2.5 Reduction



- Nationwide PM2.5 decreased 6.5 $\mu\text{g}/\text{m}^3$ (1980-2000)
- California PM2.5 decreased 13 $\mu\text{g}/\text{m}^3$ (1987-2006)



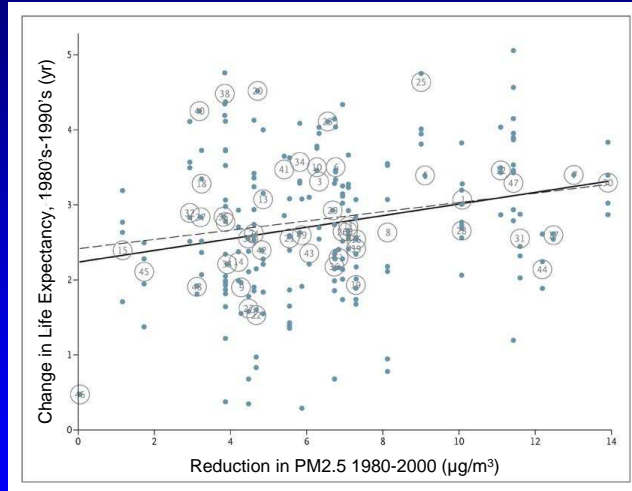
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This slide shows how public exposure to PM2.5 has changed over the years.

Nationwide, PM2.5 decreased 6.5 $\mu\text{g}/\text{m}^3$ during the study period. In California, PM2.5 decreased 13 $\mu\text{g}/\text{m}^3$ from 1987 to 2006.

In California, there has been about a four percent improvement in air quality per year over the last twenty years, due primarily to the Board's motor vehicle and diesel engine control programs, as well as the continued implementation of stringent local district rules on combustion sources.

Changes in Life Expectancy and PM2.5 1980-2000



Pope C et al. N Engl J Med 2009;360:376-386



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This figure shows the study findings in graphical form. It plots changes in life expectancy against reductions in PM2.5 from 1980 to 2000 for the 51 metropolitan areas included in the study. The trend line shows that life expectancy improves as cities reduce PM2.5.

As you can see, there is a certain amount of scatter in the data. This is to be expected, because many factors influence life expectancy other than air quality.

Study Results

- From 1980 to 2000 life expectancy improved 2.7 years in the United States
 - Due to improved health care, lifestyle, and diet
- For every decrease of $10 \mu\text{g}/\text{m}^3$ PM_{2.5}
 - Life expectancy improved 0.61 (± 0.20) years
- Reductions in PM_{2.5} accounted for 15% of life expectancy improvement



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A summary of the study findings are shown in this slide. From 1980 to 2000 the general life expectancy in the United States increased by 2.7 years. This was mostly due to improved healthcare, lifestyle, and diet.

The results of the study presented today found a decrease in PM_{2.5} of $10 \mu\text{g}/\text{m}^3$ was associated with an increase in life expectancy of 0.61 years or 7 months.

This result remained significant even after the authors made statistical adjustments for changes in socioeconomic conditions, demographics, and smoking patterns.

During the last two decades life expectancy has increased by 2.7 years. The researchers calculate that about 15% of that improved life expectancy was associated with reduced PM_{2.5}.

Gains in Life Expectancy with Preventive Interventions

Disease and Intervention	Gain in Life Expectancy (in months)	
	Men	Women
Cardiovascular disease		
Statin for low LDL/ high CRP	10.2	7.9
Achievement 20% cessation rate in smokers	5.5	6.7
Reduction of diastolic BP to 88 if 90 -94	13.2	10.8
Reduction of total cholesterol		
to 200mg/dl If 200 to 239 mg/dl	6.0	4.8
to 200mg/dl if 240 to 299 mg/dl	20.4	18.0
Cancer prevention		
10 years of biannual mammography for 50 year old women		0.8
Pap smear every 3 years for 55 years for 20 year old women		3.1
Colonoscopy every 5 years for 25 years in 50 year olds	2.5	2.2



Data for slide courtesy of Dr. Telles

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This slide, kindly provided by Dr. Telles, gives some context as to how improvements in life expectancy associated with air quality compare to medical advances.

Nationally, the average increase in life expectancy attributable to improved PM2.5 was nearly 5 months. As you can see, air quality improvements over the last two decades compare favorably to the preventive interventions shown on this slide.

Conclusions

- Reductions in PM2.5 over last 20 years
 - Result in measureable improvements in life expectancy
 - Validate ARB's efforts to reduce PM2.5 exposure



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The results of this study are good news. Steps to curb PM2.5 over the last 20 years are paying off.

While many factors influenced life expectancy in the past two decades, including medical advances, income growth, and lifestyle changes, this study suggests that PM2.5 exposure has a measureable effect on longevity and validates our concerns about PM2.5 and its effects on the health of Californians.

The researchers also observed gains in life expectancy even in cities that initially had relatively clean air but made further improvements in air quality. This suggests that ongoing efforts to reduce air pollution will continue to improve public health.

This concludes my presentation, we would be happy to answer any questions you may have.